REFLECTIVE INSULATION AND RADIANT BARRIER

Cross-Reference to Related Application

This application claims the benefit of priority of U.S. provisional application No. 60/443,399, filed January 29, 2003, and U.S. provisional application No. 60/452,471, filed March 6, 2003, which are relied on and incorporated herein by reference.

Field of the Invention

The present invention relates to thermal insulation barriers used in building construction. More specifically, the present invention relates to a reflective insulation and radiant barrier intended for use in creating more than one insulating/reflective air space in wall cavities formed by parallel structural members attached to the inside of building walls.

Background of the Invention

It is well known in the art that, when installed correctly, the use of insulation helps to maintain a comfortable temperature inside a building by reducing the heat transfer out of the building during the winter and reducing the heat transfer into the building during the summer. Because the amount of heat lost in the winter and gained in the summer is reduced, insulation lowers the costs associated with heating and cooling the building.

Heat transfer occurs through wall cavities from warmer areas to cooler areas by a combination of radiation, conduction, and convection. Heat flows by conduction from a hotter material to a colder material when the two materials touch. Heat transfer by convection occurs when a liquid or gas is heated, becomes less dense, and rises. Radiant heat travels in a straight line away from the hot surface and heats anything in its path.

Mass insulation such as fiberglass, cellulose, or rock wool, effectively reduces heat transfer by convection, and is therefore commonly used in wood frame buildings. To reduce radiant heat transfer, it is known in the art to apply a sheet of reflective material, or "reflective insulation," between the mass insulation and the interior wallboard. Similarly, in buildings constructed using masonry block walls, where mass insulation is not used, it is customary in the art to attach furring strips to the surface of the wall for applying a sheet of reflective insulation between the block wall and the interior wallboard. Reflective insulation effectively reduces radiant heat transfer and provides convective benefit by creating one or more reflective dead air spaces within the wall cavity. The reduction in convective heat transfer is provided by reducing or dividing the wall cavity into smaller regions.

Reflective insulation systems are usually fabricated using layers of aluminum foil with a variety of backings such as kraft paper, plastic film, polyethylene bubbles, polymer foam, or cardboard. When installed, the surface of the reflective foil layer(s) should not be in contact with another surface, as this reduces the foil's ability to reflect or block heat. Thus, enclosed air spaces are customarily maintained adjacent to the reflective layers to provide highly reflective or low emittance surfaces facing the enclosed air space.

The performance of the reflective insulation is determined by three factors. First, the material(s) of the system should have low "emittance," or "emissivity," *i.e.*, below 0.10. Emittance is a measure of the energy a material gives off, or emits, by thermal radiation as a result of its temperature. Second, the material(s) should have high "reflectance," or "reflectivity," which is a measure of how much radiant heat is reflected by a material. Third, the performance of reflective insulation is dependant on the size of the enclosed air spaces. Accordingly, reflective insulation is typically positioned within the building cavity formed by

studs, furring strips, joists, or the like, to provide a highly reflective and low emittance surface facing one or more air spaces.

When installing reflective insulation near an exterior wall, it is difficult and burdensome to create more than one air space. Typically, studs, furring strips, or other support members are fastened to the inside surface of the wall. The reflective insulation is installed by either (1) inserting the insulation into the cavity created by the support members and attaching it to the sides of the support members to form a single airspace between the insulation and the interior drywall or paneling, or (2) attaching the insulation to the outside surface of the support members to form a single airspace between the insulation and the inside surface of the exterior wall. Thus, to form a second airspace, the second method must be employed and a second layer of furring strips or other support members must be attached between the insulation **100** and the interior drywall or paneling (See FIG. 7). Naturally, a method of creating a second airspace that does not require the time and expense of installing additional support members would be preferred.

In addition, conventional constructions of reflective insulation can pose several problems. First, many reflective insulation products are troublesome to manipulate, as they tend to be too pliant and require the installer to hold on to the top of the insulating sheet when attaching it to the top of the support member, a task that typically demands the use of a ladder or stool. Second, many constructions are difficult to cut without snagging and require considerable effort to shear. Third, because of the materials used in typical reflective insulation products, the sheets are known to frequently break apart during manufacture, causing more waste and adding to the manufacturing costs.

Accordingly, there is a need for a reflective insulation and radiant barrier that may be easily installed to create more than one air space in wall cavities formed by the structural

members attached to the inside of building walls, that has sufficient rigidity to allow for installation without the need of a ladder, that may be easily cut with a utility knife or similar utensil, and has sufficient tensile strength to withstand the stresses of the manufacturing process and provide a higher production yield.

Summary of the Invention

The present invention answers this need by providing a reflective insulation and radiant barrier that is folded during manufacture such that installation in wall cavities to form two or more air spaces may be carried out with ease. Specifically, the present invention relates to a reflective sheet, comprised of kraft paper having two layers of aluminum foil laminated thereto, that is folded to form an insulating panel for positioning between the structural members generally parallel to the building wall, a pair of creases for spreading along the inside surface of the structural members generally normal to the insulating panel, and a pair of tabs for attaching the reflective insulation to the face of the structural members generally parallel to the insulating panel. Accordingly, the length of the pair of creases is such that the insulating panel generally bisects the cavity formed by the structural members to create two dead air spaces.

It is thus an advantage of the present invention to provide a reflective insulation and radiant barrier that is easy to install and that creates more than one air space within the cavity formed by the structural members attached to the inside of building walls.

Another advantage of the present invention is to provide a reflective insulation and radiant barrier that increases the insulating benefits of a studded, or otherwise supported, wall at minimal cost during the construction phase.

A further advantage of the present invention is to provide a reflective insulation and radiant barrier that is easy and inexpensive to manufacture.

Yet another advantage of the present invention is to provide a reflective insulation and radiant barrier that maximizes the insulation potential of a limited space within a wall cavity.

An additional advantage of the present invention is to provide a reflective insulation and radiant barrier having a sufficiently rigid structure that permits installation without the necessity of a ladder.

Another advantage of the present invention is to provide a reflective insulation and radiant barrier that is easy to cut using a utility knife or similar utensil.

A further advantage of the present invention is to provide a reflective insulation and radiant barrier having sufficient tensile strength to withstand manufacturing stresses and therefore results in higher production yields.

These and further advantages of the present invention will become apparent after a review of the following detailed description of the disclosed embodiments.

Brief Description of the Drawings

FIG. 1 is an end cross-sectional view of a reflective sheet according to an embodiment of the present invention.

FIG. 2 is an end view of a folded reflective sheet according to an embodiment of the present invention.

FIG. 3 is a perspective view of a folded reflective sheet that has been rolled during manufacture according to an embodiment of the present invention.

FIG. 4 is an end view of a folded reflective sheet installed between two vertical support members according to an embodiment of the present invention.

FIG. 5 is an end view of a folded reflective sheet installed between two furring strips and creating two dead air spaces between a layer of mass insulation and an interior wallboard according to an embodiment of the present invention.

FIG. 6 is an end view of a folded reflective sheet installed between two furring strips and creating two dead air spaces between a masonry wall and an interior wallboard according to an embodiment of the present invention.

FIG. 7 is a cut-away view of the prior art showing a reflective insulation installed near an exterior wall between two layers of furring strips.

Detailed Description of the Invention

In an embodiment of the present invention, a multi-layer reflective insulation and radiant barrier intended for use in creating more than one insulating air space in wall cavities formed by parallel structural members attached to the inside of building walls is provided.

Referring to FIG. 1, a reflective insulation and radiant barrier according to the present invention is fabricated as a multi-layer reflective sheet **10**. The reflective sheet **10** consists of a substrate layer **12** having one or more reflective layers **14** and **16** bonded thereto. Because the combination of two reflective layers provides superior heat shielding and heat dissipation, the preferred embodiment of the present invention contains two reflective layers **14** and **16** comprising aluminum foil, each having a thickness of about 0.000250 inches. The substrate layer **12** is preferably made of 25 lb. Kraft paper. Advantageously, the two reflective layers are laminated to the substrate layer **12** using an adhesive lamination process.

According to this embodiment, the reflective sheet **10** has sufficient rigidity such that it will not yield when grasped from a point slightly below the top of the sheet **10**. This provides an advantage during installation, described below. Further, a reflective sheet **10** of this embodiment may be cut using a utility knife or other utensil with relative ease, but has sufficient tensile strength to withstand the stresses incurred during manufacture and reduces the occurrences of tearing. These advantages of the preferred embodiment of the present invention are obtained without sacrificing the thermal performance of the reflective insulation and radiant barrier.

In other embodiments, the reflective layers **14** and **16** may comprise any highly reflective material such as copper, chromium, nickel, gold, silver, metalized polyester, or the like, or any combination thereof, and may be constructed having any suitable thickness (typically less than 0.005 inches). In still other embodiments, the reflective sheet **10** may be perforated and may only contain one reflective layer **14**. The substrate layer **12** may alternatively be made of any material that may be folded, creased, and rolled into a coil, such as reinforced paper; plastic film, flexible cardboard, polymer foam, or the like. It will also be appreciated that the reflective layers **14** and **16** may be bonded to the substrate layer **12** using any conventional bonding technique.

Referring to FIG. 2, during manufacture, the reflective sheet **10** of the present invention is folded upon itself along its longitudinal edges using a slot folding tray. Such folding creates an insulating panel **20,** a pair of creases **22**, and a pair of tabs **24**, all of which aid in the installation of the reflective sheet **10**, subsequently described. The folding of the reflective sheet **10** also facilitates the stacking or coiling of the sheet **10** when in storage after manufacturing and before installation. Accordingly, as shown in FIG. 3, the reflective sheet **10** is delivered to the installer in 16 inch or 24 inch wide rolls, such widths corresponding to the spacing between vertical parallel support members in building construction. It will be appreciated that the

reflective sheet **10** may be constructed of various widths if so required by local building codes or a particular installer.

Referring to FIG. 4, an end view of the folded reflective sheet **10** installed between two parallel vertical studs **40** according to an embodiment of the present invention is shown. To install the reflective sheet **10**, the sheet **10** is first grasped at one end by each corner and the tabs **24** are pulled to expand the sheet **10**. Starting at the top of the wall cavity, the insulating panel **20** is inserted into the wall cavity between the studs **40** and the tabs **24** are placed directly onto the face of the studs **40**. Moving down one side, one of the tabs **24** is then attached by staples **30** or other fasteners to one of the studs **40** by inserting the staples **30** or other fasteners through the tab **24** and into the face of the stud **40** approximately every 6 inches. The creases **22** are then spread along the inside surface of the studs **40** in order to position the insulating panel **20** generally in the middle of the wall cavity. Finally, staples **30** or other fasteners are inserted through the second tab **24** and into the face of the second stud **40** approximately every 6 inches to attach the other side of the reflective sheet **10**. Accordingly, two air spaces **50** are formed, one on each side of the insulating panel **20**, between the exterior wall and the subsequently installed interior wallboard.

It will be appreciated that because of the rigidity of the reflective sheet **10**, resulting from the Kraft paper substrate and the laminated construction, it is not necessary for the installer to hold on to the top of the tabs **24** in order to attach the tabs **24** to the top of the studs **40**. The installer may grasp the sheet **10** from below the top of the tabs **24** without the sheet **10** falling away from the face of the studs **40**. Specifically, a reflective sheet **10** of the present invention provides for a maximum length of approximately four (4) feet being unsupported below the top

of the sheet **10** during installation. Therefore, the present invention provides for ease of installation in that the use of a ladder or stool is not required.

Referring to FIG. 5, in another embodiment of the present invention, the folded reflective sheet **10** may be installed near an exterior wall **60** between two parallel vertical furring strips **45** to create two dead air spaces **50** between a layer of mass insulation **70** and an interior wallboard **80**. Because the insulating panel **20** generally bisects the wall cavity created by the furring strips **45**, the air spaces **50** on each side of the insulating panel **20** have a width of approximately 3/8 inch to 3/4 inch.

Referring to FIG. 6, in yet another embodiment of the present invention, the folded reflective sheet **10** may be installed near a masonry wall **90** between two parallel vertical furring strips **45** to create two dead air spaces **50** between the masonry wall **90** and an interior wallboard **80**.

Although FIGS. 5 and 6 illustrate the reflective sheet **10** of the present invention disposed between furring strips **45**, it will be appreciated that the inventive reflective insulation and radiant barrier may be deployed within a number of structures, including but not limited to purlins, joists, studs, or rafters, in a residential or commercial building environment.

Having thus described the invention in detail, it should be apparent that various modifications and changes may be made without departing from the spirit and scope of the present invention. Consequently, these and other modifications are contemplated to be within the spirit and scope of the following claims.